

FOR OFFICIAL USE

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Total for  
Sections  
B and C

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**X007/12/02**

NATIONAL  
QUALIFICATIONS  
2014

FRIDAY, 16 MAY  
1.00 PM – 3.30 PM

BIOLOGY  
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

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Town

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Forename(s)

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Surname

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Date of birth

Day    Month    Year

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Scottish candidate number

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Number of seat

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**SECTION A—Questions 1–30 (30 Marks)**

Instructions for completion of Section A are given on *Page two*.

For this section of the examination you must use an **HB pencil**.

**SECTIONS B AND C (100 Marks)**

- (a) All questions should be attempted.  
(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.
- The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, **and must be written clearly and legibly in ink**.
- Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the Invigilator and should be inserted inside the **front** cover of this book.
- The numbers of questions must be clearly inserted with any answers written in the additional space.
- Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the Invigilator.
- Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.



### Read carefully

- 1 Check that the answer sheet provided is for **Biology Higher (Section A)**.
- 2 For this section of the examination you must use an **HB pencil**, and where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) and **Centre Name** printed on it.  
Do not change any of these details.
- 4 If any of this information is wrong, tell the Invigilator immediately.
- 5 If this information is correct, **print** your name and seat number in the boxes provided.
- 6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).
- 7 There is **only one correct** answer to each question.
- 8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.
- 9 At the end of the examination, put the **answer sheet for Section A inside the front cover of this answer book**.

### Sample Question

The apparatus used to determine the energy stored in a foodstuff is a

- A calorimeter
- B respirometer
- C klinostat
- D gas burette.

The correct answer is **A**—calorimeter. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).



### Changing an answer

If you decide to change your answer, carefully erase your first answer and using your pencil fill in the answer you want. The answer below has been changed to **D**.



## SECTION A

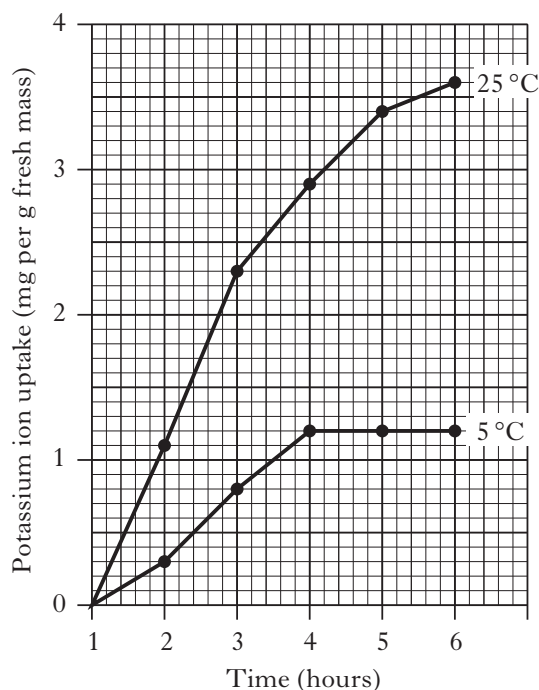
**All questions in this section should be attempted.**

**Answers should be given on the separate answer sheet provided.**

1. The action spectrum of photosynthesis shows the ability of green plants to

- A use light for photolysis
- B absorb all wavelengths of light in photosynthesis
- C absorb different wavelengths of light in photosynthesis
- D use light of different wavelengths for photosynthesis.

2. The graph below shows the uptake of potassium ions by carrot tissue at different temperatures.

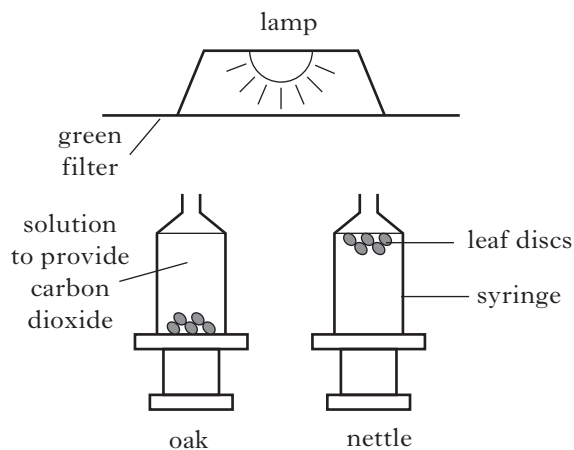


At 6 hours, how many times greater is the uptake of potassium ions at 25 °C compared with 5 °C?

- A 1.2
- B 2.0
- C 2.4
- D 3.0

3. An investigation was carried out to compare photosynthesis in green light by oak and nettle leaves. Five leaf discs were cut from each plant and placed in syringes containing a solution to provide carbon dioxide.

The diagram below shows the positions of the leaf discs after one hour.

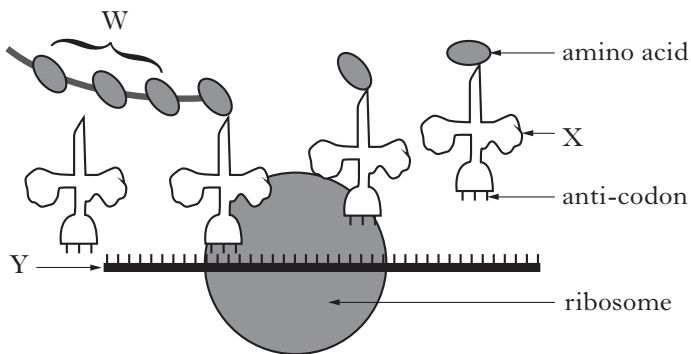


How could the investigation be improved to allow valid conclusions to be drawn?

- A Carry out the experiment in a darkened room.
- B Use different species of plant.
- C Use more leaf discs.
- D Repeat the experiment.

**[Turn over**

4. The diagram below represents a stage in protein synthesis in a cell.



Which line in the table below identifies correctly molecules W, X and Y?

	<i>Molecules</i>		
	W	X	Y
A	tRNA	mRNA	polypeptide
B	polypeptide	tRNA	mRNA
C	mRNA	tRNA	polypeptide
D	polypeptide	mRNA	tRNA

5. Which line in the table below shows correctly where ATP is synthesised in a yeast cell respiring anaerobically?

	<i>Site of ATP synthesis</i>	
	<i>Mitochondrion</i>	<i>Cytoplasm</i>
A	Yes	No
B	No	Yes
C	No	No
D	Yes	Yes

6. Four stages in the process of phagocytosis are shown below.

- 1 Lysosomes fuse with vacuole
- 2 Bacterium becomes enclosed in vacuole
- 3 Bacterium is digested by enzymes
- 4 Breakdown products pass into cytoplasm

In which sequence do these stages occur?

- A 1, 2, 3, 4
- B 2, 1, 3, 4
- C 2, 3, 1, 4
- D 1, 2, 4, 3

7. Which substances must be provided by host cells for the synthesis of viruses?

- A Proteins and nucleotides
- B Amino acids and DNA
- C Proteins and DNA
- D Amino acids and nucleotides

8. The following events occur during the replication of a virus.

- 1 Alteration of host cell metabolism
- 2 Production of viral protein coats
- 3 Replication of viral DNA

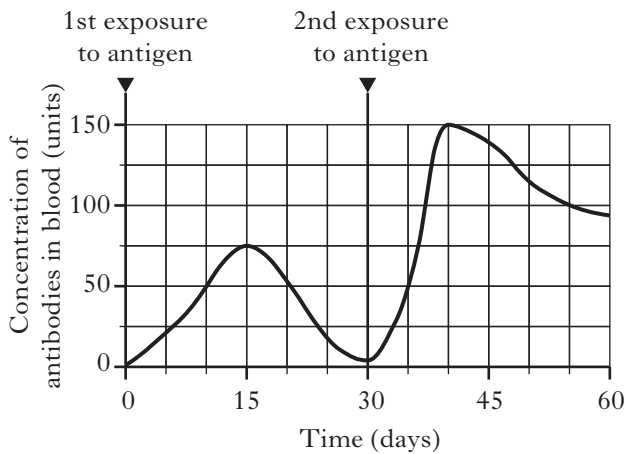
In which sequence do these events occur?

- A 1 → 3 → 2
- B 1 → 2 → 3
- C 2 → 1 → 3
- D 3 → 1 → 2

9. Which of the following statements about antibodies is **not** correct?

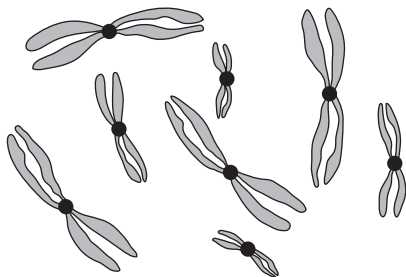
- A They are specific to antigens.
- B They are globular proteins.
- C They are produced by phagocytes.
- D They are involved in tissue rejection.

10. The graph below shows the concentration of antibodies in the blood of a patient after repeated exposures to a foreign antigen.



What is the percentage increase in the concentration of antibodies in the patient's blood 10 days after the second exposure compared to 10 days after the first exposure?

- A 33%  
 B 67%  
 C 100%  
 D 200%
11. The chromosomes of a gamete mother cell are shown in the diagram below.



How many chromosomes would be present in each gamete produced?

- A 2  
 B 4  
 C 8  
 D 16

12. Which of the following are produced by meiosis?

- A Haploid cells of identical genetic composition  
 B Diploid cells of different genetic composition  
 C Diploid cells of identical genetic composition  
 D Haploid cells of different genetic composition

13. In a species of pea plant, dwarfness and white petal colour are caused by recessive alleles found on separate chromosomes. The corresponding dominant alleles are tallness and coloured petals.

If a dwarf plant with white petals is crossed with a plant heterozygous for each characteristic, what proportion of the offspring would be expected to be dwarf plants with white petals?

- A 1 in 3  
 B 1 in 4  
 C 3 in 16  
 D 9 in 16

14. The inheritance of eye colour in fruit flies is sex-linked and the allele for red eyes **R** is dominant to the allele for white eyes **r**.

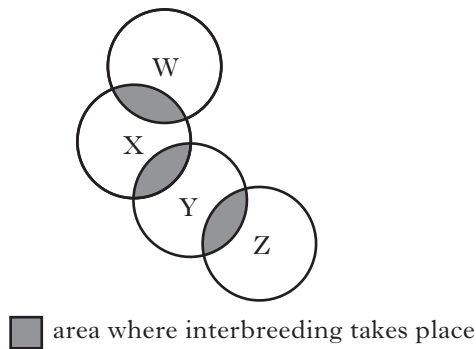
The offspring from a cross were all red-eyed females and white-eyed males.

What were the genotypes of the parents?

- A  $X^rX^r$        $X^RY$   
 B  $X^RX^r$        $X^RY$   
 C  $X^RX^r$        $X^rY$   
 D  $X^RX^R$        $X^rY$

[Turn over

15. The diagram below represents four populations W, X, Y and Z of a small mammal and the areas where they interbreed.

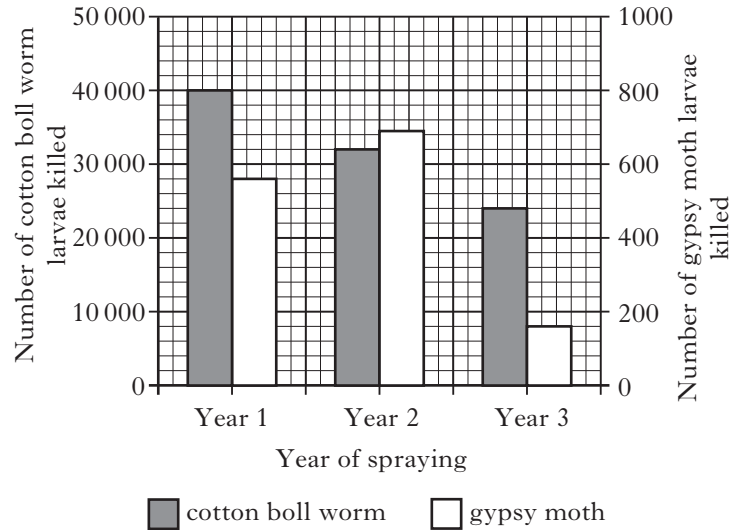


How many species are present?

- A 1  
 B 2  
 C 3  
 D 4
16. Which line in the table below identifies correctly the enzyme required and structures fused together in the process of somatic fusion of plant cells?

	<i>Enzyme required</i>	<i>Structures fused together</i>
A	cellulase	plasmids
B	cellulase	protoplasts
C	endonuclease	protoplasts
D	endonuclease	plasmids

17. The larvae of gypsy moths and cotton boll worms are pests of tree leaves. An experimental plot of infested trees was sprayed with insecticide in three different years. The numbers of each larvae killed in each year is shown in the graph below.

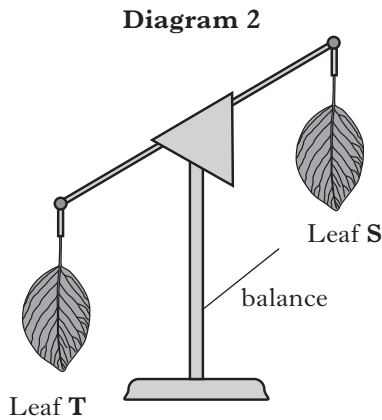
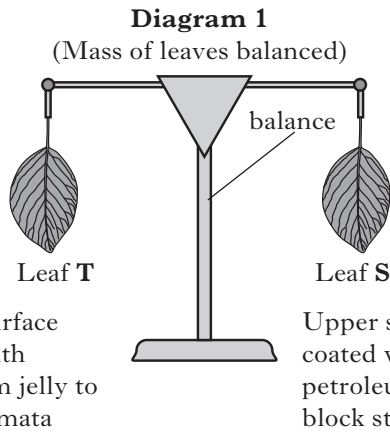


Which of the following conclusions can be drawn?

- A More gypsy moth larvae were killed than cotton boll worm larvae in year 2.  
 B The larvae became more resistant to the insecticide each year.  
 C The number of gypsy moth larvae killed was always less than cotton boll worm larvae killed.  
 D The percentage of cotton boll worm larvae surviving decreased each year.
18. Huntington's disease is caused by a single dominant allele of a gene which is not sex-linked.
- A woman's father is heterozygous for this condition and her mother is unaffected.
- What are the chances of this woman inheriting Huntington's disease?
- A 75%  
 B 67%  
 C 50%  
 D 25%

19. Leaves of the same size were cut from the same plant and treated as shown in **Diagram 1**.

**Diagram 2** shows how the apparatus appeared after being left for one hour in a warm dry environment.



Which of the following statements relating to the results of this experiment is correct?

- A Leaf T has more stomata than leaf S.
- B Leaf S has more stomata than leaf T.
- C The leaves have more stomata in their lower epidermis than in their upper epidermis.
- D The leaves have more stomata in their upper epidermis than in their lower epidermis.

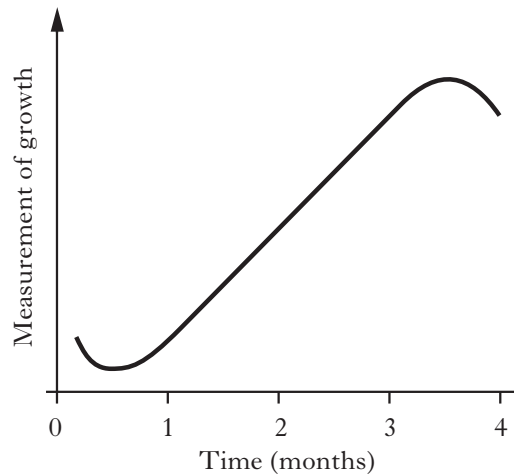
20. The list below shows statements about some animal species.

- 1 Common quail rest together in groups.
- 2 European hedgehogs have spines on their skin.
- 3 Grey wolves hunt in packs.
- 4 Kittiwakes nest in colonies.

Which statements describe social mechanisms for defence?

- A 1 and 4 only
- B 1, 3 and 4 only
- C 2 and 3 only
- D 2 and 4 only

21. The graph below shows the pattern of growth of an organism over a period of 4 months.



The graph shows changes in the

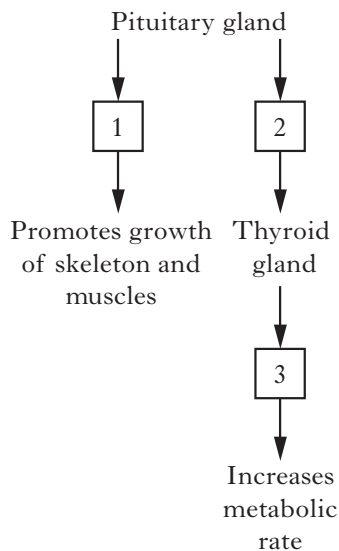
- A mass of an insect
- B dry mass of an annual plant
- C length of an insect
- D length of an annual plant.

[Turn over

22. Which line in the table below provides correct information on control of body temperature in mammals?

	<i>Monitoring centre</i>	<i>Form of communication</i>	<i>Effector organ</i>
A	skin	hormonal	liver
B	skin	nervous	brain
C	hypothalamus	hormonal	liver
D	hypothalamus	nervous	skin

23. The diagram below shows the relationship between the pituitary gland and some processes of growth and development in humans.



Which line in the table below identifies correctly the hormones 1 to 3?

	1	2	3
A	Thyroxine	Growth hormone	TSH
B	TSH	Growth hormone	Thyroxine
C	Growth hormone	Thyroxine	TSH
D	Growth hormone	TSH	Thyroxine

24. In a germinating barley grain, gibberellic acid (GA) stimulates the production of
- $\alpha$ -amylase by the aleurone layer
  - $\alpha$ -amylase by the endosperm
  - maltose by the aleurone layer
  - maltose by the endosperm.

25. The list below shows processes which affect plants.

- Leaf abscission
- Fruit formation
- Photoperiodism
- Apical dominance

Which processes involve indole acetic acid (IAA)?

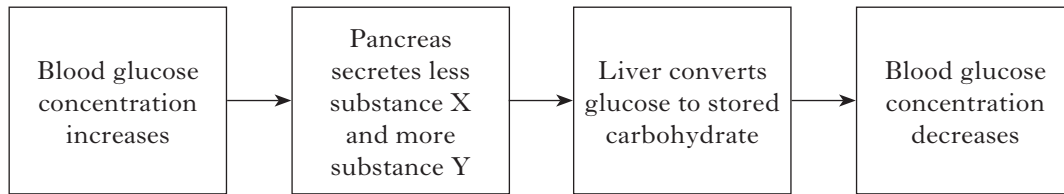
- 1 and 3 only
- 2 and 3 only
- 1, 2 and 4 only
- 3 and 4 only

26. In humans, vitamin D plays an essential role in the absorption of

- amino acids
- lipids
- iron
- calcium.



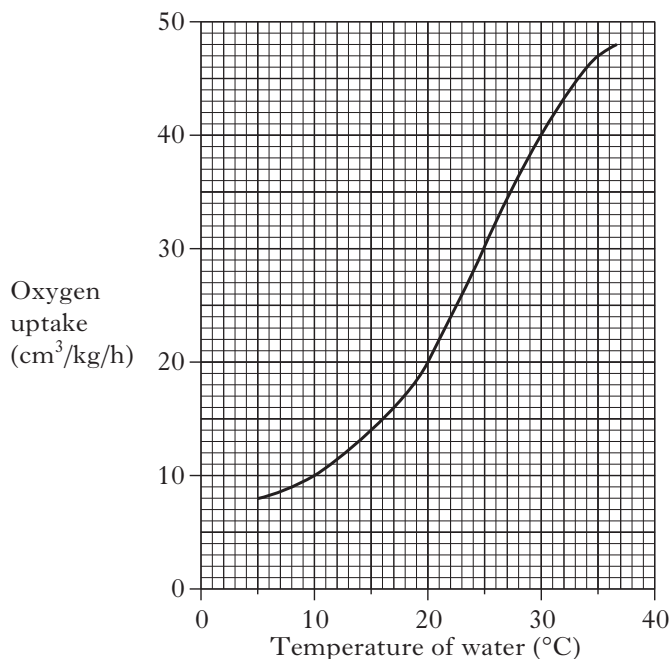
27. The flow chart below shows some events in the control of the concentration of glucose in the blood.



Which line in the table below identifies correctly substances X and Y?

	<i>Substance X</i>	<i>Substance Y</i>
A	insulin	glucagon
B	insulin	glycogen
C	glucagon	insulin
D	glycogen	insulin

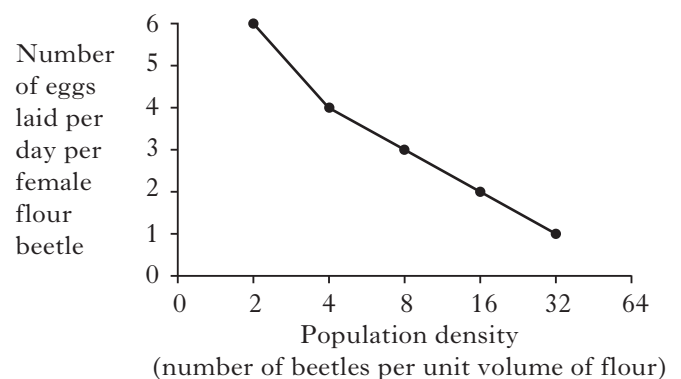
28. The graph below shows how the rate of oxygen uptake of a tropical fish species in an aquarium varies with water temperature.



The volume of oxygen uptake for a 0.25 kg fish over a 5 hour period of time at 20 °C is

- A 5 cm<sup>3</sup>
- B 20 cm<sup>3</sup>
- C 25 cm<sup>3</sup>
- D 100 cm<sup>3</sup>.

29. The graph below shows the effect of population density on the number of eggs laid per day by female flour beetles.



From the graph, the following conclusions were suggested.

- 1 Females lay fewer eggs per day as the population density increases.
- 2 Females lay more eggs per day at low population densities.
- 3 As the population density decreases, females lay fewer eggs per day.

Which of the conclusions are correct?

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

30. Which of the following factors that can limit population size is density dependent?

- A Decrease in food supply
- B Cold winter
- C Volcanic eruption
- D Pollution

**Candidates are reminded that the answer sheet MUST be returned  
INSIDE the front cover of this answer book.**

**[Turn over for Section B on *Page twelve***

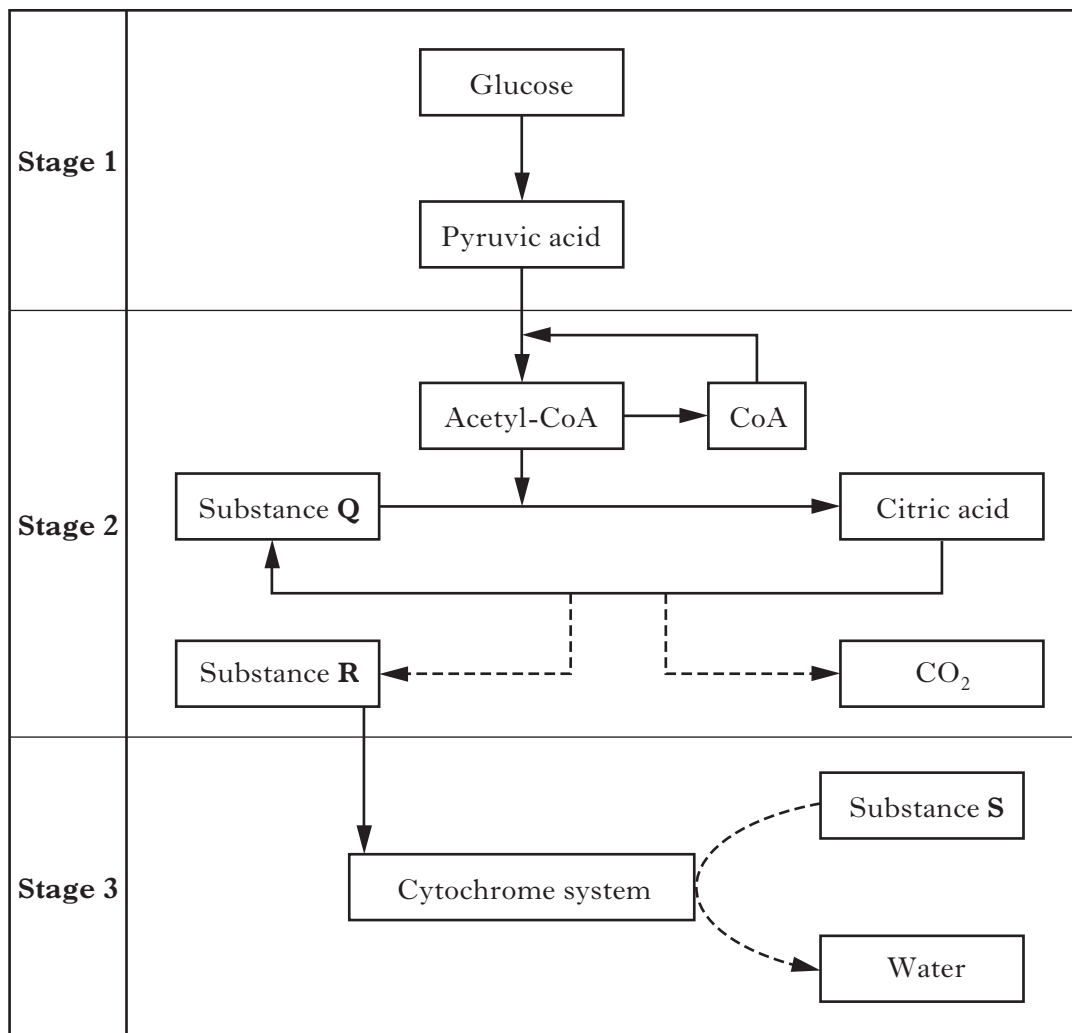
**SECTION B**

Marks

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. The diagram below shows an outline of three stages of aerobic respiration in muscle cells.



(a) Name **Stage 1**.

\_\_\_\_\_

1

(b) Complete the table below to show the number of carbon atoms in one molecule of each substance.

<i>Substance</i>	<i>Number of carbon atoms in one molecule</i>
Pyruvic acid	
Substance <b>Q</b>	
Citric acid	

2

Marks

**1. (continued)**

- (c) Name Substance **R** in **Stage 2** and the carrier which transfers it to the cytochrome system.

Substance **R** \_\_\_\_\_

Carrier \_\_\_\_\_

1

- (d) Name Substance **S** in **Stage 3** and its role in aerobic respiration.

(i) Substance **S** \_\_\_\_\_

1

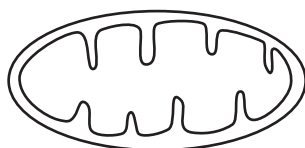
(ii) Role in aerobic respiration \_\_\_\_\_

\_\_\_\_\_

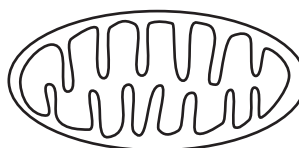
1

- (e) The diagrams below show the structure of a mitochondrion from a skin cell and one from a muscle cell.

Mitochondrion from  
skin cell



Mitochondrion from  
muscle cell



Describe the difference in structure between the two mitochondria and explain how this is related to the function of the muscle cell.

Difference \_\_\_\_\_

\_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

2

[Turn over

Marks

2. Nettles are shade plants which often grow below trees.

Their leaves contain photosynthetic pigments X and Y. The table below shows the percentage of light of different wavelengths absorbed by these pigments.

<i>Wavelength of light (nm)</i>	<i>Colour of light</i>	<i>Light absorbed (%)</i>	
		<i>Pigment X</i>	<i>Pigment Y</i>
400	violet	40	20
440	blue	60	30
550	green	5	60
680	red	50	5

- (a) Apart from being absorbed, state what else can happen to light striking the leaves of plants.

\_\_\_\_\_

1

- (b) Identify which of the pigments, X or Y, in the table is chlorophyll.  
Justify your choice.

Pigment \_\_\_\_\_

Justification \_\_\_\_\_

\_\_\_\_\_

1

- (c) (i) Describe the relationship between the wavelength of light and the percentage of light absorbed by pigment Y.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2

- (ii) Describe how the presence of pigment Y in their leaves would benefit nettle plants growing below trees.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1

Marks

3. (a) Decide if each of the statements relating to DNA in the table below is **true** or **false** and tick (✓) the appropriate box.

If you decide that the statement is **false**, write the correct term in the correction box to replace the term underlined in the statement.

<i>Statement</i>	<i>True</i>	<i>False</i>	<i>Correction</i>
The region of a DNA molecule which codes for a protein is called a <u>gene</u> .			
Pores in the nuclear membrane allow <u>DNA</u> to carry the code for a protein out of the nucleus.			
A DNA molecule has many <u>codons</u> each made up of deoxyribose, phosphate and a base.			

2

- (b) A section of a DNA molecule containing a total of 1600 bases has 184 adenine and 216 thymine bases on one strand. The complementary strand contains 268 cytosine bases.

- (i) Calculate the number of adenine bases in the **whole section** of the DNA molecule.

*Space for calculation*

\_\_\_\_\_ 1

- (ii) Calculate the number of guanine bases in the **complementary** strand.

*Space for calculation*

\_\_\_\_\_ 1

- (c) Name the structure in cells which transports protein from the ribosomes to the Golgi apparatus.

\_\_\_\_\_

1

*Marks***3. (continued)**

(d) The list below shows different proteins.

- 1 cellulase
- 2 collagen
- 3 insulin
- 4 endonuclease

Use numbers from the list to complete the table below.

<i>Class of protein</i>	
<i>globular</i>	<i>fibrous</i>

2

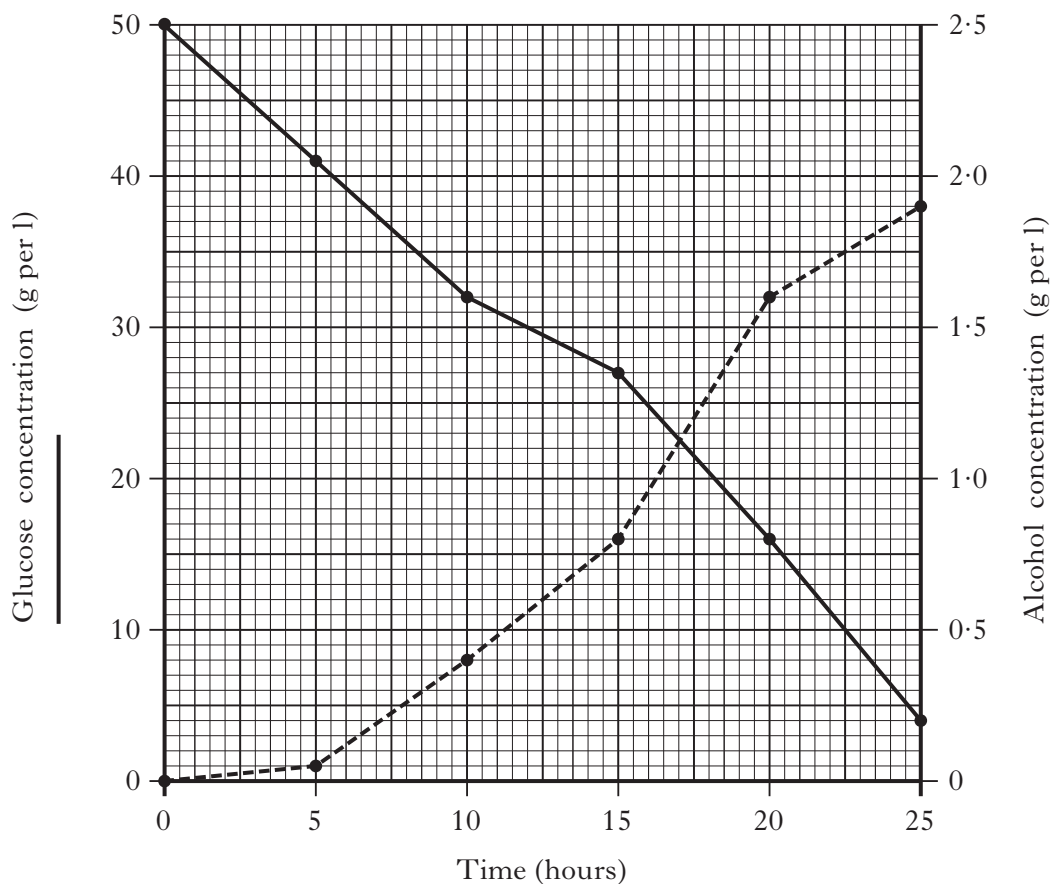


4. A culture of yeast was grown in 5 litres of glucose solution.

Glucose and alcohol concentrations in the culture were measured every 5 hours for 25 hours.

Marks

The results are shown in the graph below.



(a) State the alcohol concentration when the glucose concentration was 10 g per litre.

\_\_\_\_\_ g per litre **1**

(b) Tick (✓) the box to identify the time period during which the rate of alcohol production was the greatest.

0 – 10 hours	5 – 15 hours	10 – 20 hours	15 – 25 hours
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**1**

(c) Identify the time at which the glucose concentration reached 50% of its starting concentration.

\_\_\_\_\_ hours **1**

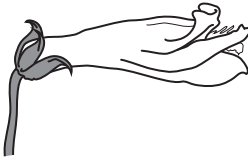
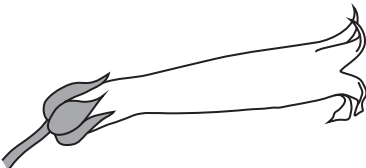
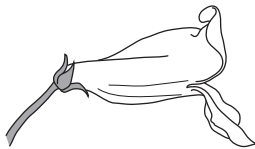
(d) Calculate how many grams of glucose remained in the solution at the end of the investigation.

Space for calculation

\_\_\_\_\_ g **1**

Marks

5. In North America, three species of *Penstemon* plants have evolved from a single species. The plants are pollinated by animals that feed on nectar found in nectaries inside their flower tubes, close to the base.

<i>Species</i>	<i>Scale drawing of flower tube</i>	<i>Specialised pollinator</i>
<i>Penstemon grinnellii</i>		large bees
<i>Penstemon centranthifolius</i>		hummingbirds
<i>Penstemon spectabilis</i>		wasps and small bees

- (a) Use the information above to explain how the evolution of the *Penstemon* species illustrates adaptive radiation.

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2

- (b) Several species of hummingbird compete for *Penstemon centranthifolius* nectar. Name the type of competition involved in this example.

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1

- (c) The various pollinators must forage economically. Explain what is meant by this statement in terms of energy.

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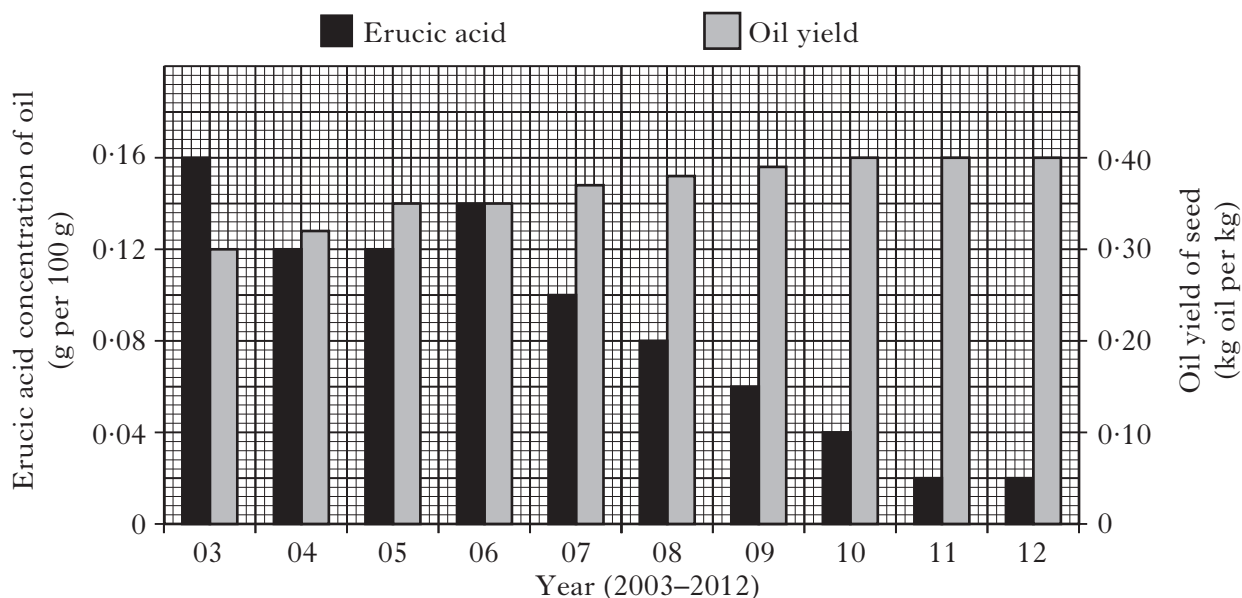
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**[Turn over for Question 6 on *Page twenty***

6. Oil from wild varieties of oilseed rape plants contains a high concentration of erucic acid which makes the oil unsuitable for human consumption. Selective breeding programmes have produced modern varieties of oilseed rape plants with oil of low erucic acid concentration which is suitable for human consumption.

In 2003 a new selective breeding programme was started which aimed to further reduce the erucic acid concentration of the oil and to increase oil content of seeds.

The **bar chart** below shows the results of the new selective breeding programme over a 10 year period.



(a) (i) Use values from the **bar chart** to describe the changes in erucic acid concentration of the oil from 2005 until 2012.

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2

(ii) Calculate the simplest whole number ratio of the erucic acid concentration in the 2003 harvest compared with that of the 2011 harvest.

*Space for calculation*

\_\_\_\_\_ in 2003 : \_\_\_\_\_ in 2011

1

(iii) Calculate the mass of seed from 2012 which would be needed to produce one kilogram of oil.

*Space for calculation*

\_\_\_\_\_ kg

1

Marks

## 6. (continued)

- (b) The bacterium *Bacillus thuringiensis* produces Bt-toxin, a substance harmful to leaf-eating insects. Some oilseed rape plants were genetically engineered so that they contained the gene for Bt-toxin.

A field trial was set up to compare seed yields in genetically engineered plants with the Bt-toxin gene and control plants without the Bt-toxin gene. Equal numbers of the two types of plant were grown under identical conditions in the presence of leaf-eating insects and their seed yield per hectare compared.

The results of the trial are shown in the **table** below.

<i>Plants</i>	<i>Seed yield</i> (kg per hectare)
Genetically engineered (with the Bt-toxin gene)	144
Control (without the Bt-toxin gene)	80

- (i) Calculate the percentage increase in the seed yield per hectare from plants with the Bt-toxin gene compared with the control plants.

*Space for calculation*

\_\_\_\_\_ % **1**

- (ii) Explain why the genetically engineered plants produce a higher yield of seed per hectare compared with the control plants.

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**2**

- (iii) The selectively bred plants which produced the 2012 harvest were affected by leaf-eating insects.

Using information from the **table** and the **bar chart**, predict the increase in **oil yield** per hectare which could have been achieved, if these plants had been:

- genetically engineered to contain the Bt-toxin gene
- grown under identical conditions to those in the field trial.

*Space for calculation*

Increase in oil yield: \_\_\_\_\_ kg oil per hectare **1**

[Turn over

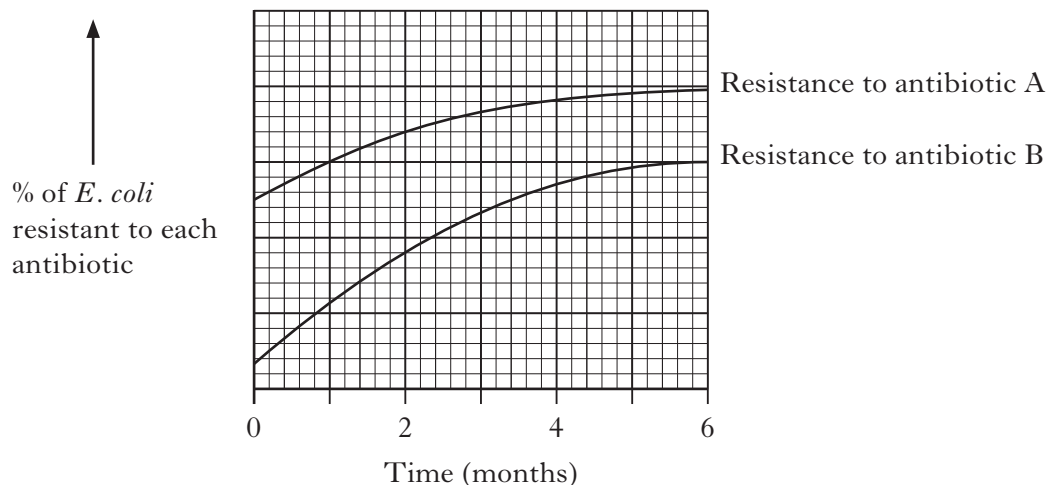
Marks

7. The bacterium *Escherichia coli* lives in the intestines of domestic pigs. New generations of *E. coli* can arise every twenty minutes under ideal conditions.

An investigation was carried out over a six-month period during which time pigs were regularly injected with a mixture of antibiotics A and B.

At regular intervals during this investigation, *E. coli* from the intestines of the pigs were sampled and tested for antibiotic resistance.

The graph below shows changes in the percentage of *E. coli* in the samples which were resistant to each antibiotic.



- (a) Explain how the increase in resistance to antibiotic B has arisen by natural selection.

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2

- (b) The pigs in this investigation had previously been treated with one of the antibiotics.

Identify this antibiotic and justify your answer with evidence from the graph.

Antibiotic \_\_\_\_\_

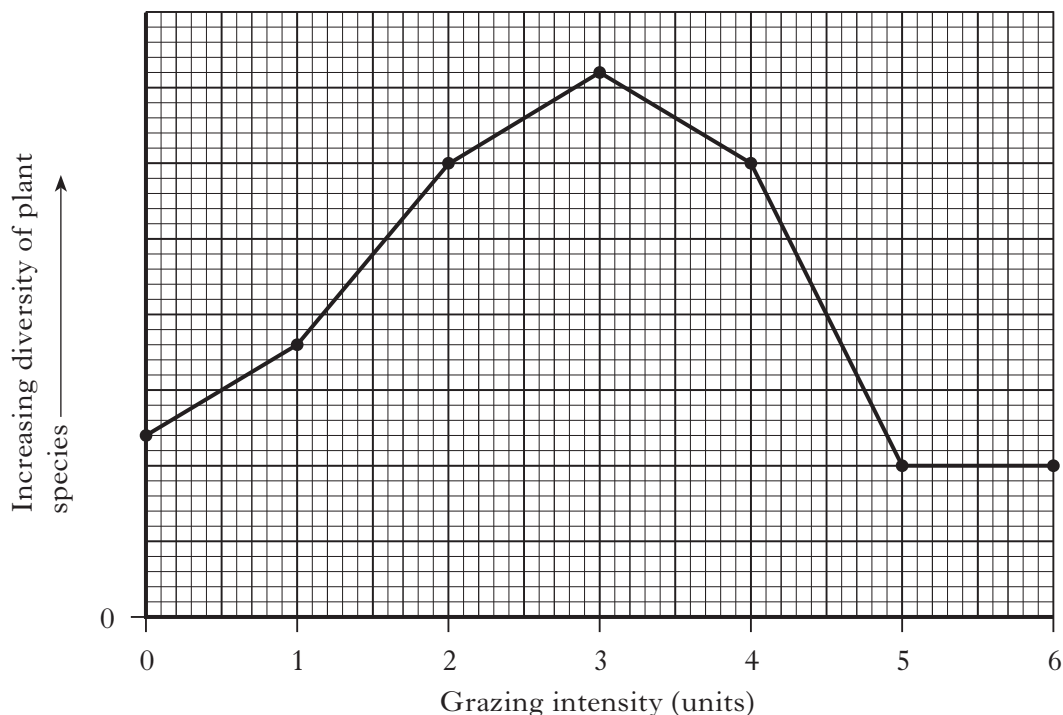
Justification \_\_\_\_\_

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1

Marks

8. The graph below shows how the intensity of grazing by rabbits affects the diversity of plant species in an area of grassland.



- (a) Explain the change in diversity of plant species shown on the graph between 0 and 3 units of grazing intensity.

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2

- (b) (i) Give evidence from the graph that indicates that the grassland contained some plant species that are tolerant of grazing.

---



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1

- (ii) Give **one** adaptation that allows plants to tolerate grazing.

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1

[Turn over

*Marks*

**8. (continued)**

(c) Some plants have adaptations that allow them to discourage grazing.

(i) Name a structural defence mechanism that allows some species to discourage grazing.

\_\_\_\_\_

**1**

(ii) Name a substance produced by the cells of some species that discourages grazing.

\_\_\_\_\_

**1**



Marks

9. (a) The table below relates to adaptations for maintaining water balance in desert rats.

Complete the table by adding information to each empty box.

<i>Type of adaptation</i>	<i>Description of adaptation</i>	<i>Effect of adaptation</i>
physiological		avoids water loss by evaporation from skin
	nocturnal	reduces water loss by evaporation during the day
		increases reabsorption of water by the kidney

2

- (b) The grid below shows the adaptations of bony fish for osmoregulation.

A	many, large glomeruli	B	few, small glomeruli
C	low kidney filtration rate	D	high kidney filtration rate
E	chloride secretory cells absorb salts	F	chloride secretory cells secrete salts

- (i) Give **three** letters from the grid which identify adaptations of salt water bony fish.

\_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_

1

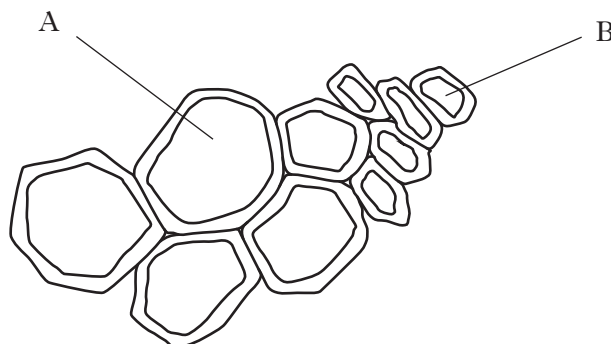
- (ii) Give **two** letters from the grid which identify adaptations leading to the production of high volumes of urine.

\_\_\_\_\_ and \_\_\_\_\_

1

Marks

10. (a) The diagram below shows part of a section through a woody stem of a pine tree enlarged to show some of the vessels which make up the xylem tissue.



- (i) Give the letter which identifies the xylem vessel formed in spring.

Give a reason for your answer.

Letter \_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

1

- (ii) Name the meristem responsible for producing cells which differentiate into xylem vessels in a woody stem.

\_\_\_\_\_

1

- (iii) Name the area in a cross section of a woody stem that represents the xylem growth occurring in one year.

\_\_\_\_\_

1

- (b) Explain the production of differentiated tissue such as xylem in terms of gene activity.

\_\_\_\_\_

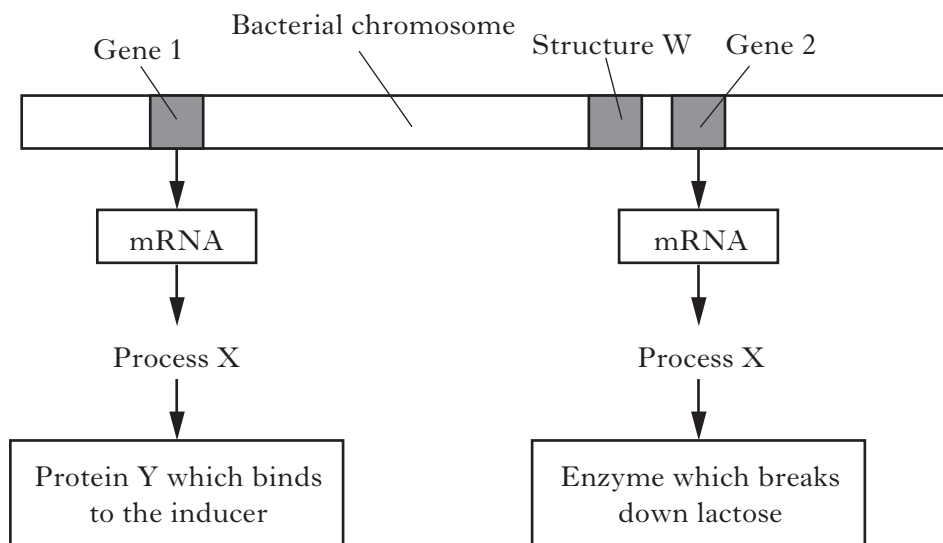
\_\_\_\_\_

\_\_\_\_\_

1

Marks

11. The diagram below shows information relating to the Jacob-Monod hypothesis for the control of gene action in the bacterium *Escherichia coli*.



- (a) Complete the table below.

<i>Structure</i>	<i>Name</i>	<i>Function</i>
Gene 1		Codes for protein Y
Structure W	operator	
Gene 2		Codes for the enzyme which breaks down lactose

2

- (b) Name process X.

\_\_\_\_\_

1

- (c) (i) Name the inducer.

\_\_\_\_\_

1

- (ii) Explain the advantage to *E. coli* of this type of control of gene action.

\_\_\_\_\_  
\_\_\_\_\_

1

Marks

12. An investigation was carried out to study the effects of exercise on sweat production in humans.

An exercise bike was placed in a laboratory with constant humidity and temperature.

A healthy 30-year-old male exercised on the bike for five trials of different durations as shown in the table below. The average rate of sweat production during each trial was calculated.

There was a recovery period after each trial to allow sweat production to return to normal level.

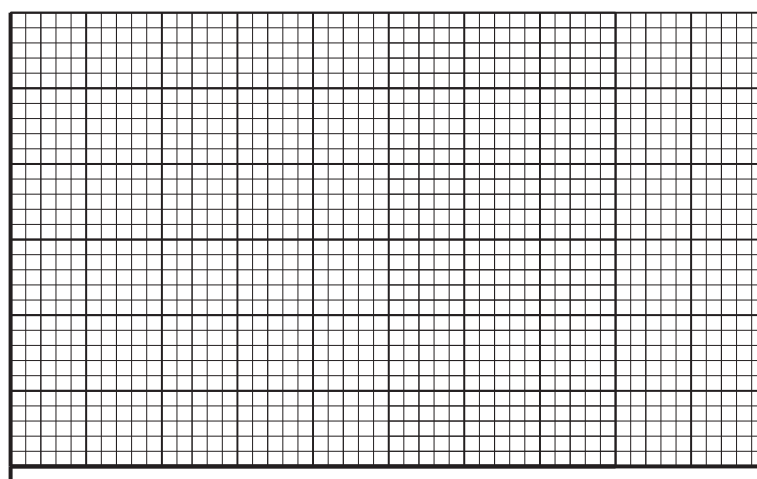
The results are shown in the table below.

<i>Exercise trial</i>	<i>Duration of exercise trial (s)</i>	<i>Average rate of sweat production (mg per cm<sup>2</sup> skin per minute)</i>
1	30	0.10
2	60	0.21
3	90	0.32
4	120	0.43
5	150	0.45

- (a) On the grid below draw a line graph of average rate of sweat production against the duration of exercise.

Choose an appropriate scale to fill most of the graph paper.

(Additional graph paper, should it be required, will be found on *Page forty*.)



30

2

- (b) (i) Give **two** variables, not already described, which should be kept constant to allow valid comparison of the exercise trials.

1 \_\_\_\_\_

2 \_\_\_\_\_

2

Marks

## 12. (b) (continued)

- (ii) State how the procedure could be improved to increase the reliability of the results.

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1

- (c) Explain how the units of sweat production used in this investigation would allow a valid comparison between different individuals to be made.

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1

- (d) Calculate the total mass of sweat produced per  $\text{cm}^2$  during exercise trial 3.

*Space for calculation*

\_\_\_\_\_ mg per  $\text{cm}^2$

1

- (e) Predict the rate of sweat production which would be expected in an exercise trial with a duration of 180 seconds.

\_\_\_\_\_ mg per  $\text{cm}^2$  per minute

1

- (f) (i) Sweat production is a corrective mechanism used in the regulation of body temperature.

Explain why maintaining body temperature within tolerable limits is important to the metabolism of humans.

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1

- (ii) Give the term used for animals which use changes in metabolism to regulate their body temperature.

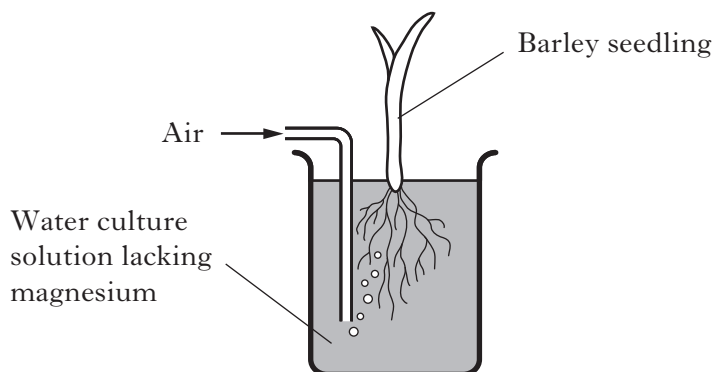
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1

[Turn over

Marks

13. (a) The diagram below shows apparatus used in a water culture experiment to investigate the effect of the lack of magnesium on the growth of barley seedlings. The water culture solution provided all the elements needed for normal plant growth apart from magnesium.



- (i) Describe a suitable control for this investigation.

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1

- (ii) Explain why bubbling air into the water culture solution increases the uptake of elements by barley roots.

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2

- (iii) Other than overall reduction in growth, give **one** symptom of the deficiency of magnesium on the development of barley seedlings.

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1

- (b) State **one** role of iron in the growth and development of humans.

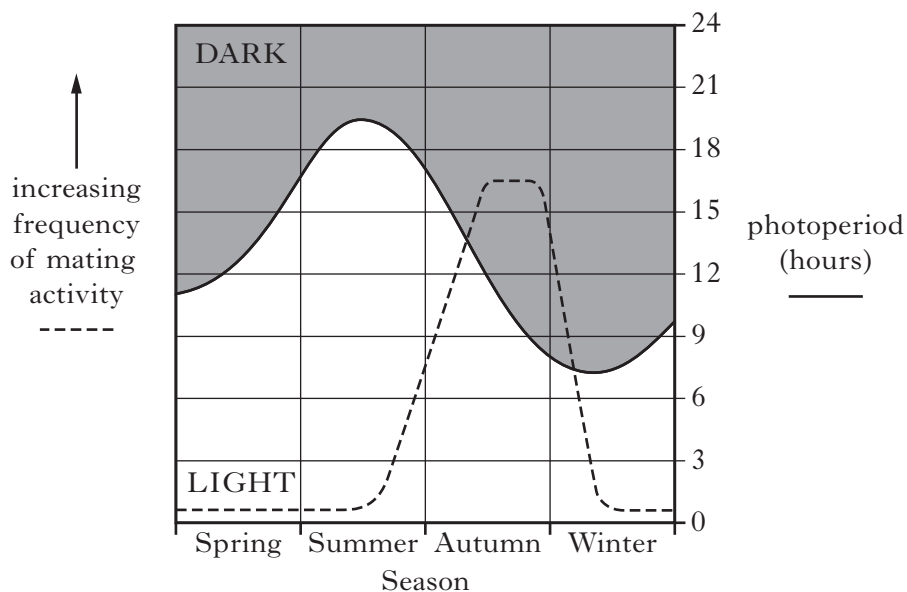
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1

Marks

14. (a) The mating behaviour of red deer is influenced by photoperiod.

The graph below shows how the frequency of mating activity of the deer is related to photoperiod.



(i) Give the photoperiod at which frequency of mating activity first reaches its maximum.

\_\_\_\_\_ hours **1**

(ii) Suggest how the timing of mating behaviour is an advantage to red deer.

\_\_\_\_\_  
\_\_\_\_\_ **1**

(b) (i) State the term used to describe the growth movements of plant shoots towards light.

\_\_\_\_\_ **1**

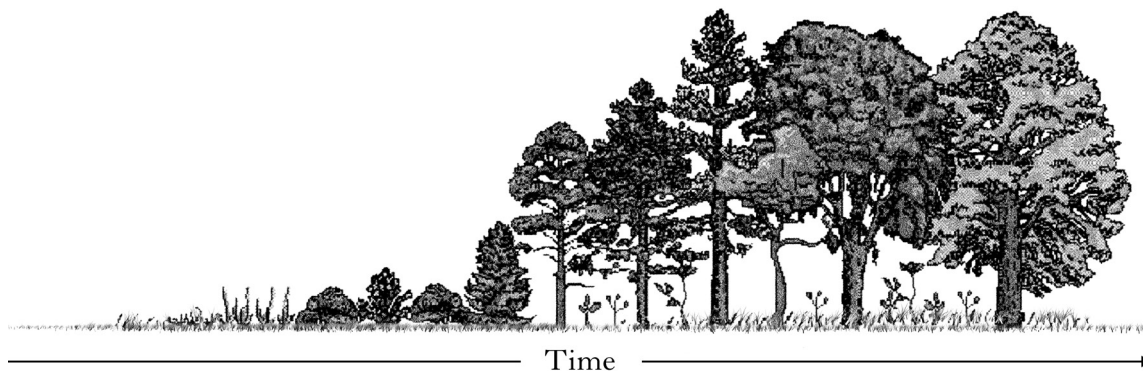
(ii) State the environmental conditions under which a plant shoot would become etiolated.

\_\_\_\_\_ **1**

[Turn over

Marks

15. The diagram below shows the changes in the plant communities present at various times after a field was abandoned.



<p><b>Pioneer communities</b> colonise abandoned field within one year</p>	<p><b>Intermediate communities</b> develop over 150 years</p>	<p><b>Final community</b> established 200 years after the field was abandoned</p>
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- (a) Give the term used to describe the process of gradual change in plant communities shown in the diagram.

\_\_\_\_\_

1

- (b) Give the term used to describe the final community in this process.

\_\_\_\_\_

1

- (c) State **one** difference between a pioneer community and a final community.

\_\_\_\_\_

1



**SECTION C**

**Both questions in this section should be attempted.**

Note that each question contains a choice.

**Questions 1 and 2 should be attempted on the blank pages which follow.**

**Supplementary sheets, if required, may be obtained from the Invigilator.**

**All answers must be written clearly and legibly in ink.**

**Labelled diagrams may be used where appropriate.**

**1. Answer either A or B.**

**A.** Give an account of mutation under the following headings:

- |   |             |
|---|-------------|
| (i) occurrence of mutant alleles and effects of mutagenic agents; | <b>3</b>    |
| (ii) gene mutations and their effects on protein structure.       | <b>7</b>    |
|   | <b>(10)</b> |

**OR**

**B.** Give an account of adaptations of plants under the following headings:

- |  |             |
|--|-------------|
| (i) adaptations of xerophytes for maintaining a water balance; | <b>6</b>    |
| (ii) adaptations of hydrophytes to their environment.          | <b>4</b>    |
|  | <b>(10)</b> |

**In question 2, ONE mark is available for coherence and ONE mark is available for relevance.**

**2. Answer either A or B.**

**A.** Give an account of the structure of chloroplasts and the carbon fixation stage of photosynthesis. **(10)**

**OR**

**B.** Give an account of the structure of the plasma membrane and the cell wall and describe their roles in relation to osmosis in plant cells. **(10)**

*[END OF QUESTION PAPER]*

**[Turn over**

**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

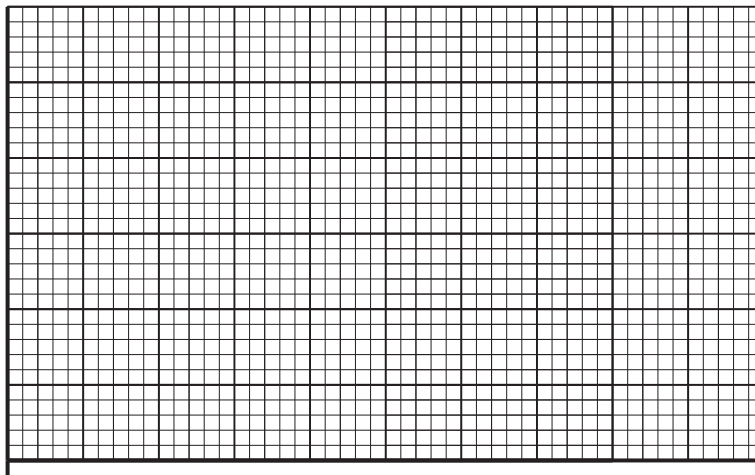
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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

ADDITIONAL GRAPH PAPER FOR QUESTION 12 (a)



30

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